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Original Articles.

WHEN TO OPEN KNEE-JOINTS.

By H. W. Marshall, M.D., Boston.

A surgeon might reply that knees should be opened whenever an operation will be of benefit. A very conservative non-operating physician might say that all other methods should be tried first.

Such differences of opinion are unavoidable because surgeons know favorable possibilities of operations most accurately and the limitations of other methods; while physicians who never operate know merits of non-surgical methods and disadvantages of operations especially. Both should be commended for their accurate special knowledge. If the ideas of both are collected, shuffled together, and all fitted carefully then on anatomical and physiological foundations without trying to show advantages of any special clinical method strikingly, there will result modified points of view of interest. The writer will try to deal briefly with a few common knee affections with this aim in view.

SYNOVITIS.

A tall, lean, muscular Dane fifty-one years old, cement finisher by trade, was at work on his hands and knees when suddenly he felt a sharp pain in one knee. He was in average health at the time as far as he was aware, and he did not traumatize his knee except in rather rough usage of repeated kneeling. Pain persisted and the knee became swollen. He entered an excellent hospital and submitted to an arthrotomy six days after the onset of his trouble. The operation was done skillfully and consisted in making a large incision above the patella which permitted thorough examination of the joint and quadriceps pouch. More than five months after the operation when the writer first examined him there was normal motion practically in flexion and extension of the leg and no abnormal lateral mobility existed at the knee. The operation wound had healed perfectly with no stretching or adherence of the scar. There was no abnormal joint crepitus nor abnormal joint effusion. The capsule of the joint was not thickened, and on the whole the knee had a very normal appearance.

Is this result a decided success that shortened the course of joint inflammation, or should it be interpreted as undesirable treatment which disabled the patient a longer time than if he had not been operated on? His attitude now happens to be a dissatisfied one because his knee is still too sensitive to kneel on continuously, and because it gives out on descending stairs, so that he is unable to accept other work.

Statistics from series of clinical cases will not answer such a question as the foregoing one conclusively. There are some exceptionally brilliant results both in operated and non-operated groups, and differences between them are not convincing. Operations do not abort all cases quickly at least, and conservative physicians point out that many patients who refuse operations subsequently recover completely in approximately same lengths of times, as many of those who undergo surgical treatment. Yet, perhaps, such patients might have recovered even more quickly than they did if they had submitted to arthrotomies.

Anatomical and physiological considerations have to be turned to when indeterminate situations are encountered in clinical evidence. It is certain that arthrotomies accompanied by irrigations of joint cavities remove synovial accumulations that sometimes possess toxic properties. It is true also that irrigation fluids exert some physiological influence on synovial linings. Incisions into joints when the latter are distended with excess of synovial fluid relieve intracapsular pressures and tend to prevent capsular stretchings. These points will be discussed in turn.

Synovial accumulations may have two important actions. Increase of fluid separates synovial surfaces and protects them when in an irritated state by reducing mechanical frictions in subsequent joint movements. This is an extremely beneficial influence that is liable to be lost sight of among prominent pathological symptoms and signs. Accumulated synovial fluid contains toxic substances, without doubt, when it has a purulent character, and under these circumstances it exerts a mixed influence. In instances in which micro-organisms are not demonstrable in synovial fluids and which comprise a large percentage of cases, theoretically there may or may not be present toxic substances which have leaked through synovial capillaries out of toxic circulating blood. It is not known in the majority of clinical cases actually whether beneficial or harmful influences predominate in synovial accumulations.

If formations of synovial fluids are recalled, it will be remembered that serous fluids pass through capillary walls into connective tissue spaces. Connective tissues become oedematous and there may be proliferations of connective tissue elements if irritations are greatly prolonged.

Linings of joint cavities apparently exert selective actions on serous fluids because synovial contents are more than simple transudates. It would not be surprising if some protective action of synovial linings against passage of blood toxins into joints is found at some future time. Possibly toxins are partly restrained in connective tissue spaces out of reach of irrigating fluids, but nothing definite is known of existing conditions.

It is known that synovia resist a considerable amount of sepsis inside joint cavities successfully at times, so that joints may be closed tightly after washing them out, although some staphylococci have been present in the serous fluid.

Experiences with penetrating wounds of knee-joints in war injuries have shown surgeons repeatedly that many such knees can be left several weeks quietly, with profit, until joint resistances have increased.

Then joints can be opened, cleaned out, and closed, generally with best results; because synovial linings possess peculiarities analogous to those of peritoneal surfaces. Both are able to take care of variable amounts of internal septic irritation depending on the normal reactions of healthy tissues of healthy individuals.

Septic joints of pyaemic origin often are restored to normal function again to surprising degrees when joint drainage is avoided. Drainage is being found to be indicated less and less frequently.

When discharging joint sinuses exist, the utility of early, gentle massage, even during subsiding stages of acute inflammations, is becoming more widely recognized as such treatment is conducted skillfully in a manner to accelerate lymphatic circulation about inflamed regions.

Various details of surgical care of septic joints must be left, however, to papers that present convincing case reports.

Synovial fluid varies within wide limits. It may be clear and straw colored, or turbid with cell débris. It may contain fibrin in scanty quantities or in severe very chronic inflammations there may be loose jelly-like moulds of fibrin filling the joints. At times it has characteristics of an inflammatory exudate even consisting of frank pus. Synovial fluid normally contains salts, proteids, a mucin-like substance and water, and it has a variable specific gravity.

Irrigating fluids possess differing physiological influences, depending on their chemical and physical properties, and practically there should be included with physiological influences of irrigations also mechanical frictions sustained in moving joints to and fro while attempting to introduce fluids into all parts of joint cavities. At times irrigations simply mean introductions of small streams that trickle out again promptly as small streams, without coming into contact generally with synovial surfaces. If irrigation fluids are of proper chemical natures and of right concentrations, of proper temperatures, and if they reach all parts without harmful mechanical irritations of joint surfaces, then the latter will be favorably stimulated, probably, by single applications to slight degrees. When synovial tissues already are struggling unsuccessfully with increasing blood-carried toxins, their resistances may become very low, and conceivably they may be embarrassed rather than slightly relieved by added influences of joint irrigations at these particular times, especially it the latter are not precisely correct in nature. Clinical evidence does not disprove that a large percentage of irrigations are useless or slightly harmful in their direct influences on synovial linings at onsets of inflammatory processes. In subsiding stages of acute synovitis, however, there is more data to base judgments on in estimating the advantages of arthrotomy. Tissue resistances then are increasing and some irrigations that might have been too strong for earlier stages are more liable to be favorable in their actions on more stable tissues. Explorations of joint cavities in subsiding or late stationary stages of severe synovitis furthermore permit removals of fibrinous clots that might lead to adhesions of serious nature, also they allow inspection of synovia at times when tubercular infections or villous hypertrophies are suspected.

Single irrigations in subsiding stages of synovitis with immediate subsequent closures of joints cannot produce very great influences. And irrigations of joints toxically irritated through the blood are in a different class from the repeated irrigations of septic joints when the latter have been caused by local infections from penetrating wounds.

Continued extreme capsular stretching by synovial accumulations should be prevented undoubtedly, in order to avoid subsequent laxities of ligaments as well as to prevent bacterial infiltrations of weakened joint capsules and subsequent chronic inflammatory thickenings. Operations have distinct advantages over purely non-operative measures in this respect, but large accumulations can be kept down by aspirations and tight elastic pressures.

Defects of surgical technique occasionally occur and lead to impaired results of treatment, but these are too well understood to demand discussion. Surgeons realize that best results depend on most evenly balanced judgments exercised in all details of operative procedures. Poor results may be traced at different times to origins in any one of the minor steps of an operation, such as too extensive or too small incisions, handling of tissues, infections, suture material, drainage, control of hemorrhage, closure of incisions, post-operative care.

In the illustrative case that has been cited, the patient was dissatisfied because his knee was not dressed until seven days had elapsed after his operation. Then a large quantity of fluid squirted, so he states, from the operation wound when one end was purposely opened to liberate the subcutaneous accumulation of serum. He erroneously interpreted a good surgical practice as gross neglect.

Subcutaneous serous exudates may be derived, it should be recalled in passing, from reactions of tissues to surgical handling; also, possibly, to subsequent leakage from the joint cavity, and from rapid drainage of oedematous periarticular tissues.

It may be claimed by some surgeons that formations of sterile subcutaneous serous accumulations accelerate anatomical recoveries and tend to avoid capsular thickenings. Others may argue that there would be more rapid restorations of synovial functions with quicker subsidence of joint tenderness, as exhibited in the patient whose case has been cited, if synovial surfaces had been left more perfectly protected by a slight accumulation of fluid within the joint, and perhaps both views are correct.

CONCLUSIONS REGARDING ARTHROTOMIES FOR SYNOVITIS.

1. Arthrotomies are generally harmless when done by skillful surgeons. Patients are placed conveniently for efficient control of other steps in treatment when they are in hospitals, and excellent recoveries are the rule in instances of non-purulent synovitis.

2. Early arthrotomies are unnecessary, as well as harmless in non-purulent cases, and great

advantages which are unattainable otherwise do not result from them. Important advantages are not shown convincingly in series of clinical cases, nor do arthrotomies possess marked theoretical superiorities in early cases.

3. Arthrotomies performed during later stages of slowly subsiding chronic knee inflammations of considerable severity possess distinct advantages. They permit examinations of synovial linings for evidences of beginnings of tuberculosis, developing villous enlargements, and other internal knee derangements. They allow removal of fibrinous clots that might lead to serious adhesions, and possibly exert minor accelerating effects towards recoveries of synovial functions from single applications of irrigating fluids.

4. Excessive conservatism in opening knee-joints should be avoided because of the harmlessness of surgery when operations are skillfully done, and because of their positive benefits in selected instances.

5. Conclusions with regard to the illustrative case that has been cited are that it is impossible to decide positively from clinical data alone whether surgery has prolonged or shortened this patient's disability.

The writer's interpretation of the case is that perfect surgery prevented capsular stretching, the joint capsule and periarticular tissue outdistancing the synovial lining in return to a normal state again. At the present time, when capsular and periarticular thickening has disappeared almost to the point of slight atrophy from disuse there is practically perfect motion, but the temporarily slightly impaired function of the synovium which is shown in persisting tenderness and joint weakness, perhaps, would not be of such marked degree now if the synovium had been more perfectly protected continously by a moderate excess of joint fluid.

If no operation had been performed probably the various reparative processes would have kept pace more evenly with each other. There might be a little more stiffness and soreness of periarticular origin with less noticeable synovial tenderness and joint weakness. With more restricted motion and less noticeable weakness, he might be at work which did not require kneeling. But differences in results of operative and non-operative treatment in cases like this one probably are not large or of very great practical importance.

Before protective synovial fluids are washed out in early cases, there should be knowledge that they are more toxic than beneficial in nature, but to ascertain such points convenient, new biochemical reactions of joint fluids are needed that are still undiscovered.

Recent advances in knowledge of joint physiology, moreover, tend to emphasize the importance of maintaining local lymph circulation. Perhaps post-operative conditions with complete rest are inferior to slight voluntary shiftings in positions of joint structures from time to time when synovia are protected naturally by joint effusions.

VILLOUS ARTHRITIS.

Villous arthritis is characterized by chronic thickenings of synovia, including synovial villi and fringes that occur normally in knee-joints. Clinically these conditions give evidence of their existence in unusual crepitus when joints are moved as the hypertrophied tissues interfere with each other or get pinched between bearing surfaces.

Causes producing initial thickenings of joint linings include traumata, toxemias and bacterial infections, or combinations of these different factors. From almost imperceptible beginnings, synovial thickenings may increase under continued influence of normal joint use, and through continued mechanical frictions accompanying activity irritate or pull out folds in the lining if the latter get caught between bearing surfaces until, in some instances, pedunculated or free joint bodies are produced.

Well-developed villous arthritis may terminate in a variety of ways.

1. Subsidence and complete restoration of joint functions are most common results after variable numbers of months depending on severity of villous hypertrophies and efficiency of treatments.

2. Continued interference with joint functions for a year or longer from hypertrophied synovia may result, because of repeated new injuries, or continuance of toxemias or infections, or neglect of treatment, or from combinations of these causes.

3. Under these circumstances joint effusions increase and subside alternately, depending on fluctuating amounts of irritation. Capsules weaken and stretch or thicken if they become chronically inflamed by infiltrations of micro-organisms. Such states are compatible with very considerable activity for years, neverthe-

less, and a few patients manage to endure chronically weakened enlarged knee-joints without ceasing their usual occupations and without proper medical care.

4. Tubercular disease may develop in thickened synovial linings. Presumably such infections can occur at any period in the course of knee inflammations, or they may be initial causes of synovitis in some instances. All that can be stated positively is that some hypertrophied synovial tissues are found to be tubercular on surgical exploration, and some are not tubercular.

5. Pedunculated villi or detached loose bodies may be formed gradually that eventually slip into comparatively non-obstructing positions from which they emerge at irregular intervals to produce intermittent acute symptoms, or not infrequently they become adherent in non-obstructing positions and more permanent relief than is obtained.

6. Operations are performed with benefit in many instances and at all stages of villous hypertrophy. The topic of surgical treatment overlaps to considerable extent the one concerning operations for synovitis previously mentioned.

OPERATIONS FOR VILLOUS ARTHRITIS.

Conveniences and activities of patients are involved rather than matters of life and death, and accordingly there are widely differing reasons in different cases for or against operative interference. Patients' occupations and positions in life, as well as severity and chronicity of symptoms, hold important place in determining what shall be done. Each problem should become an individual one in which the patients' wishes as well as the strictly medical viewpoints are taken into consideration in arriving at decisions as to most appropriate methods of treatment.

When operations are performed the following clinical results are possible:

1. Removals of pedunculated villi or loose bodies which have been causing marked symptoms are followed by marked relief immediately when wounds have healed and walking has been resumed.

2. Too much synovial tissue is removed at times apparently, especially in less severe types and from supracondylar pads of fat. Patients then complain of sensations of weakness persisting for long periods subsequently, and they have some difficulties in stepping up to or down from different levels.

3. Extremely gradual changes for better or worse take place after operations many times that should not be interpreted generally as results of surgical interference. The changes would have taken place, presumably, whether or not surgical treatment had been received in the majority of instances. Usually such very slow post-operative changes take place in middle-aged persons whose joints also show definite osteo-arthritic bony changes that have been developing for years.

Simple arthrotomies with careful removals of small bits of synovial tissues probably represent minor incidents in the progress of joints toward steady deterioration under continued faulty vascular conditions in these middleaged patients. At times operations under these circumstances appear to produce a little improvement for awhile, and on the other hand the unavoidable trauma that attends surgical interference is sufficient to accelerate downward tendencies not infrequently. In all such instances the position of main importance is held by osteo-arthritic disease rather than villous accompaniments.

4. Practical experience proves that arthrotomy with excision of thickened synovial tissue from vigorous young adults at least does not do very much harm when operative technique is executed skilfully, and perfect recoveries of joint functions very often are met with after conservative surgical treatments.

Surgical management provides excellent control of patients, and enables some to recover more quickly because they could not be persuaded otherwise to remain quiet for sufficiently long periods to permit their chronically inflamed knees to recover.

Many arthrotomies that are done for villous arthritis probably are unnecessary as well as harmless especially in the earlier stages.

OTHER KNEE INFECTIONS.

Loosened or detached semilunar cartilages, torn crucial ligaments, fractures of patellae, tibiae and femora, tuberculosis, and neoplasms, all necessitate opening of knees at times; but only a few points relating to some of these topics can be mentioned in this brief paper.

Loose semilunar cartilages may act like pedunculated villi and interfere with joint motions. When there are recurring attacks of acute symptoms removals of cartilage fragments are followed promptly by decided relief. Occasionally partly loosened cartilages fall back into normal positions apparently and become reattached without operations if new injuries are avoided, similarly as pedunculated villi slip into non-obstructing places and occasionally become adherent.

There is little harm in waiting during early stages in many instances of cartilage dislocation in spite of occasional abrupt interference with normal motions. When there is a serious inconvenience experienced, then cartilages should be operated on but unnecessary surgery can be avoided safely by conservative methods. As with cases of villous arthritis, each patient should be treated according to individual medical and non-medical peculiarities of the situation.

Complete ruptures of crucial ligaments are serious complications of knee-joint injuries that cannot be discussed, nor can precise indications be given for opening knees after fractures. There may be marked synovial irritations following fractures which make surgical interference advisable because of chronic thickenings, while in other instances slightly crushed tibial heads or femoral condyles repair and readjust themselves best without operations.

Tuberculosis of knee joints of adults should be treated by joint excisions as soon as synovial tissue has been proved definitely to be tubercular by microscopic examination. When tubercular knees of adults are made stiff, the general health usually improves and they are able to resume active lives. When excisions are not made, then tubercular knees continue to cause intermittent or constant trouble, knee functions gradually diminishing, and in a few neglected instances final spontaneous ankylosis following long disability accomplishes by natural means what is quickly done by surgical excisions.

Non-tubercular joint adhesions in septic cases produce complete ankylosis, or more or less limitations in ranges of joint movements, and with or without accompanying pain. There have been devised operations to restore motion in completely ankylosed joints by means of animal membranes and fascia after adhesions have been loosened. On the other hand, painful knees with greatly restricted motions sometimes are made fixed and painless by operations as tubercular knees are treated, or there may be attempts at increasing the range of motions by distending joint capsules with olive oil or other fluids. Obviously each case must be treated individually on its particular merits with reference to anatomic range of motion and physiological degrees of pain and weakness represented.

WHEN NOT TO OPEN KNEE-JOINTS.

No attempts at knee-joint surgery should be made unless proper facilities for strict surgical asepsis are at hand because serious impairments of joint functions do occur occasionally as results of operations, and many questionable minor advantages gained through early opening of many clean joints are overbalanced if serious harm is done in a few other instances.

Post-operative infections develop occasionally when surgical asepsis has been perfect. This is possibly by blood infections. If weakened joint tissues have their resistance lowered still further by long and clumsily executed operations with much handling of tissues and with attempts at local sterilizations by means of very strong local applications, then circulating micro-organisms sometimes gain foothold if surgical abuse exceeds certain limits although surgical asepsis has been maintained scrupulously.

A young man seen recently by the writer had been troubled to a moderate degree with a joint-mouse that could be felt at times very plainly beneath the joint capsule. He had submitted to an operation which was done under strict surgical precautions under local anesthesia. The joint body was found to have deep inaccessible attachments that could not be cut for some reason, and after protracted trial the knee was closed with the joint-mouse still *in situ*. After several months of incapacity from a swollen painful knee, there was good return of function, but he refuses further treatment of surgical nature now.

Many middle-aged patients with chronic hypertrophic arthritis should not be submitted to arthrotomies except for unusual reasons, because pathological processes are liable to be accelerated rather than retarded by operations frequently. Degenerative changes taking place in Charcot knees also seem to be accelerated frequently by surgical interference. Hemophilic joints should not be opened, and there are a host of borderline cases of various sorts about which there will be controversies always as to most appropriate methods of treatment. All that can be said is that each case should receive careful consideration from point of view of patients' probable future activities as well as from probable harmlessness of surgical measures, therefore moderate conservatism in operating should be advocated for the majority of cases.

It is the writer's belief that most radical and enthusiastic surgeons should be supported in their skillful attempts to extend the scope of surgery when they operate on venturesome patients who are willing to take necessary risks and consequences. Surgery has to depend on them both for its wider extension and its most rapid progress.

On the other hand, doubtful or unnecessary operations should not be performed in fairness on patients who expect conservative treatment without unnecessary hazards.

Extreme conservatism seems as desirable in some instances as extreme surgical enthusiasm, and between these limits somewhere the majority of cases should be grouped for greatest satisfaction to patients and for continued welfare of the medical profession.

THE ENERGY REQUIREMENTS OF GIRLS FROM 12 TO 17 YEARS OF AGE.

By Francis G. Benedict and Mary F. Hendry, Boston.

[From the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Massachusetts.]

(Continued from page 286.)

INSENSIBLE PERSPIRATION.

By insensible perspiration is meant that loss in weight of the body not attributable to the loss of solid or liquid excreta. It consists for the most part of water vaporized from the lungs and skin, but contains also a relatively small amount of organic carbon and hydrogen oxidized from the body material. Consisting as it does so largely of water vapor, it is subject naturally to such fluctuations as affect the water vapor output. In all probability the main factor affecting insensible perspiration is muscular activity, either minor or major. If this is the case, the insensible perspiration may be looked upon as a more or less crude index of the total metabolism.

In spite of the relative simplicity of the technique for determining the insensible perspiration, we have been able to find in the literature no data for young girls other than those of Camerer.[19] Among his values dealing with the ages interesting us are those for two girls. One girl, at the age of 12½ years, with a body weight of 32.6 kgs., showed an average loss per kilogram per hour for 24 measurements of 0.74 gram, while at the age of 15 years, with a body weight of 43.3 kgs., she showed an hourly loss of 0.51 gram per kilogram. With another girl at the ages of 13, 14½, and 17 years, with body weights of 30.3, 35.7, and 39.6 kgs., the average hourly loss per kilogram was 0.73, 0.62, and 0.55 gram, respectively.

It was possible for us to measure the insensible perspiration of our girls on six different nights, and our data for these nights are given in Table VIII. The time represented by the measurements was approximately from 10.30 P.M. to 7.15 A.M. As in the pulse table (Table III), those girls who had not reached maturity, *i.e.*, who had not begun to menstruate, are indicated by numbers underlined. An examination of the data in Table VIII for those girls who were present on more than one night is of interest, first, as showing the influence of apprehension caused by the novelty of the observations, resulting in inability to go to sleep immediately or in restless sleep. The data for these girls indicate that there was a slightly higher insensible loss during the first night than during the second or third nights, and consequently one can conclude that our figures are on the whole perhaps a little higher than they normally would be if the girls had been subjected to repeated observations. The several groups of girls appear in Table VIII in the order of decreasing age, while within the groups themselves the data are given according to decreasing body weight. This arrangement of the values enables us to note if there is any influence of age or weight upon the insensible loss. A careful inspection of the table shows that no apparent correlation exists between either age or weight and insensible perspiration per kilogram of body weight.

Laying particular stress upon the loss per kilogram per hour, we see that only in a few instances are values over one gram noted, and it is probably true that these values are affected by some extraneous factor, such as excessive muscular activity. If we make the wholly arbitrary and fairly questionable assumption that these values of one gram and over are abnormal and average the values below one gram, we find that the averages for the several groups are as given in Table IX. Here we

TABLE VIII.—INSENSIBLE PERSPIRATION OF GIRLS 13 TO 15 YEARS OF AGE.

Date, average age, and subject number[1]	Body weight (without clothing)	Insensible perspiration	
		Per hour[2]	Per kilo. per hour
1920	kgs.	gms.	gms.
Jan. 16-17			
14 yrs. 10 mos.			
31	61.5	42	0.68
28	57.3	29	.51
29	54.5	51	.94
34	52.8	40	.76
26	50.5	38	.75
32	47.9	30	.63
25	45.8	40	.87
30	45.5	40	.88
27	45.1	35	.78
33	44.0	39	.89
24	43.5	33	.76
Avg.	49.9	38	.77
April 9-10			
14 yrs. 1 mo.			
39	62.2	40	.64
35	57.2	28	.49
91	46.7	28	.60
90	45.3	25	.55
44	45.1	45	1.00
89	41.4	35	.85
93	40.8	30	.74
94	40.8	27	.66
88	37.0	27	.73
95	35.8	29	.81
92	33.8	26	.77
Avg.	44.2	31	.71
March 19-20			
14 yrs.			
86	71.5	41	.57
39	59.9	30	.50
80	56.6	46	.81
46	55.7	29	.52
81	55.7	32	.57
83	52.5	28	.53
79	50.6	32	.63
87	48.6	31	.64
82	44.8	34	.76
44	44.5	30	.67
84	41.0	30	.73
85	38.8	22	.57
Avg.	51.7	32	.63
1920	kgs.	gms.	gms.
Jan. 23-24			
13 yrs. 8 mos.			
39	59.2	48	0.81
35	58.7	40	.68
45	56.7	47	.83
38	55.3	47	.85
40	52.7	42	.80
37	50.7	43	.85
41	49.2	40	.81
44	44.2	54	1.22
42	42.2	56	1.33
43	41.7	39	.94
36	33.3	37	1.11
Avg.	49.4	45	.93
Feb. 13-14			
13 yrs. 4 mos.			
35	58.2	31	.53
38	56.2	47	.84
46	54.2	26	.48
50	42.7	24	.56
47	41.7	29	.70
49	41.7	21	.50
52	41.7	29	.70
53	40.7	30	.74
48	40.2	46	1.14
51	36.7	34	.93
54	36.2	64	1.77
36	33.7	27	.80
Avg.	43.7	34	.81
March 12-13			
12 yrs. 10 mos.			
68	47.4	42	.89
78	47.4	28	.59
74	46.0	35	.76
75	41.6	30	.72
73	39.9	38	.95
72	38.9	39	1.03
67	36.3	36	.99
71	35.8	25	.70
70	34.6	18	.52
77	34.5	25	.72
Avg.	40.2	32	.79

see that the lowest value is found with the 14-year-old group of March 19-20 (body weight 51.7 kgs.), *i.e.*, 0.63 gram per kilogram per hour or 32 grams per hour. This figure may be taken as representing most probably the true insensible loss of a group of girls of an average age of 14 years. The extreme range in the insensible loss per kilogram per hour is from 0.63 to 0.82 gram, a range that is perhaps not surprising. Although every effort was made to secure constant temperature and relative humidity, these conditions could not be perfectly met, as shown by our records of the average temperature of the dry and wet bulbs, as well as of the relative humidity, on the six different nights.. It may be mere coincidence that the highest insensible loss per kilogram, 0.82 gram, occurred on the night with the highest temperature of the dry and wet bulbs and with the highest relative humidity, 44 per cent. The absolute minimum excretion of 0.63 gram, however, does not occur with either the highest or the lowest temperature. Theoretically one would expect that the higher the relative humidity, the less would be the vaporization of water from the lungs and skin, since the air is more nearly saturated in the beginning. It is more than likely, however, that we have to deal here not so much with the desiccating effect of dry air as with the slight influence upon comfort of the changes in humidity, and if any relationships were to be established between the temperatures and the water vaporized, *i.e.*, insensible perspiration, these would have to be looked upon almost exclusively as a secondary rather than a primary effect of the temperature and humidity. We cannot hold that our evidence speaks for a definite effect of humidity upon insensible loss.

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[1] Subject numbers underlined represent girls who have *not* reached puberty..

[2] The total period of measurement was 8¾ hours for the observations of January 16-17, January 23-24, and February 13-14; 9 hours for March 19-20; and 9¼ hours for March 12-13 and April 9-10.

THE GASEOUS METABOLISM OF GROUPS OF YOUNG GIRLS.

Quite aside from the physiological interest of the pulse rate and the insensible perspiration, our observations were primarily designed to secure evidence with regard to the total heat production of young girls while in complete muscular repose, and, as nearly as practicable, in the post-absorptive condition. It has been definitely demonstrated that with adults the basal metabolism is affected by several factors, weight, sex, age and height. By careful biometric analysis[8] each of these factors has been shown to have an independent influence, that of weight being the most pronounced. In studying the metabolism of children from birth to puberty[2] it was found that the age element *per se* played a very important rôle in the metabolism, much more so than with adults. Since the data for children were not sufficiently extensive to submit to special biometric analysis, it was not possible to show that height had an independent effect, although a sex differentiation was clearly shown. With our groups of girls, ranging in age fro m12 to 17 years, it was reasonably supposed that the age factor would not by any means have disappeared or reached the low level that it does with adults. The differentiation of the influence of the several factors, particularly age, height and weight, with young children is complicated by the fact that with children all three of these factors are simultaneously developed. As the girl grows older she increases in weight and in height. With adults no such definite relationship is established, although there are, of course, periods when there is a distinct tendency for adults to take on weight, as between 40 to 50 years, and to lose weight, as in more advanced age. It seems best, consequently, to study these girls primarily from the point of view of age, attempting to correct for the weight and other growth factors by comparisons on the basis of the metabolism per unit of weight or per unit of surface area. With children, as has been stated before, abnormal relationships between weight and height are not usually found. In other words, children run more true to type, while with adults there are many instances of obesity and not infrequently of undernutrition.

TABLE IX.—INSENSIBLE PERSPIRATION PER KILOGRAM PER HOUR OF GIRLS 13 TO 15 YEARS OF AGE.

(AVERAGE VALUES)

Date	Average age		Insensible perspiration per kilo. per hour	Temperature		Relative humidity
				Dry bulb	Wet bulb	
1920	yrs.	mos	gm.	°C.	°C.	p. ct.
Jan. 16–17	14	10	0.77	19.2	11.7	35
April 9–10	14	1	.68	18.2	11.2	37
March 19–20	14	0	.63	19.1	12.0	38
Jan. 24–24	13	8	.82	21.6	14.9	44
Feb. 13–14	13	4	.68	19.7	13.2	45
March 12–13	12	10	.76	20.2	13.6	43

From measurements of the gaseous exchange, information with regard to three distinct physiological points may be derived. In the first place, from an analysis of the oxygen deficit and the carbon-dioxide increment in the air in the respiration chamber measurements can be made of the respiratory quotient, which will indicate the character of the katabolism or the nature of the material burned, and, what is of greater practical importance for this research, which will give a clue as to the calorific value of carbon dioxide best suited for applying to the total carbon-dioxide measurements to compute the heat production. Secondly, the total carbon-dioxide production measured throughout the night is of value in indicating directly the total heat production of young girls under conditions of "bed rest." In the third place, the measurement of the minimum carbon-dioxide production during the night gives information with regard to the probable basal metabolism.

RESPIRATORY QUOTIENT.

We shall consider first the ratio between the carbon dioxide produced and the oxygen consumed, *i.e.*, the respiratory quotient. From the results obtained on two hundred or more men and women studied in the Nutrition Laboratory it has been found that the average respiratory quotient in the post-absorptive condition is 0.82. These determinations were, however, made under conditions that were strictly post-absorptive, that is, the subjects were all approximately 12 hours without food. It could not be assumed that the respiratory quotients of the groups of young girls studied in our respiration apparatus would necessarily be this value, since with the girls the measurements were made at an interval by no means as great after the last meal as in the case of the adults. The evening meal was always taken at 6 o'clock. The carbon-dioxide measurements rarely began before 11 P.M., and usually at 12 P.M.,—approximately 5½ hours after the completion of the last meal rather than the canonical 12 hours. On the other hand, both the quality and the quantity of the meal were adjusted so as to minimize the storage of glycogen. The protein content was moderately low, *i.e.*, on the average 20 grams, so that its stimulating effect was reduced. The meal may on the whole be looked upon as a rather light meal (approximately 500 calories), particularly for active girls, for it not infrequently happened that these girls came to the Laboratory after an afternoon spent in more or less severe Girl Scout drill and marching.

The respiratory quotients were determined for four groups of girls with astonishingly uniform results. Thus, values were found of 0.81 on January 2-3, of 0.81 and 0.80 on January 16-17, of 0.78 and 0.78 on January 23-24, and of 0.79 on February 13-14. Of special significance is the fact that these quotients are all lower than the average quotient of 0.82 found with adults in the post-absorptive condition. This may be in part accounted for by the relatively light supper. Moreover it is not unreasonable to suppose that these low quotients may be explained by another factor, namely, the more rapid metabolism of early youth, which has contributed to the depletion of glycogen storage or at any event has retarded the massing of any great proportion of glycogen in the body. We believe that the evidence here accumulated is sufficiently indicative to justify further investigation. A study of the effect of abundant carbohydrate feeding upon the glycogen storage of youth, similar to that made at the Nutrition Laboratory by Higgins[20] and others, on adults, should prove of great physiological importance.

Little information can be derived from the earlier respiratory quotients obtained by Benedict and Talbot, owing to the fact that these were in so many instances determined but a few hours after food. We were, frankly, considerably surprised at the low quotients found with our girls seven to eight hours after their supper. But the accuracy of the Sondén apparatus for determining both carbon dioxide and oxygen can hardly be questioned. This particular apparatus has been in use for several years and all analyses were made by one of us after several years' experience. We must take it, therefore, as highly probable that the respiratory quotient of groups of young girls eight hours after a light meal is somewhat lower than that found on the average with adults.

The consistency with which we found these seemingly low respiratory quotients made it seem undesirable for us to make the determinations in all of our tests. The deviations between the various quotients are so small as to justify, in our judgment, the use of an average value, *i.e.*, 0.79. From the practical standpoint this average quotient made it possible for us to select the most accurate calorific value of carbon dioxide to be employed in the computation of the energy transformations. Accordingly, we have used 3.086 calories as the calorific value of a gram of carbon dioxide, and the heat production has been computed by multiplying the carbon-dioxide production by this factor.

TOTAL ENERGY OUTPUT DURING BED REST.

Among the factors affecting the carbon-dioxide production are, first, the influence of the preceding meal (an influence which with these girls, as pointed out in the preceding section, must have been somewhat greater, although probably not very much greater, than that obtaining during the post-absorptive state), and second, the after-effect of muscular activity. In practically all instances the girls were undergoing a novel experience. There was considerable jollification and activity just prior to going to bed and the usual exuberance of youth found outward expression in pillow fights and in dancing and jumping about for a relatively few minutes. Unquestionably this activity stimulated the metabolism somewhat, but we believe that the preliminary period, which lasted frequently an hour or more, sufficed practically to rule out this disturbing factor. One of the requirements of the experiments was that the girls should remain quiet after going to bed and not talk or engage in any activity. This was well adhered to in general. We did not begin actual measurements until we were reasonably certain that every girl was quiet, if not actually asleep. Consequently we may fairly consider that our measurements represent the carbon-dioxide production of girls during "bed rest" and, for the most part, asleep. Since "bed rest" is a condition which plays a very important part in the 24-hour routine of every normal child, the average child spending not far from 10 out of the 24 hours in bed, while in sickness the entire 24 hours of a patient's day may be spent in bed, these carbon-dioxide values and especially the energy values computed from them have more than ordinary significance. The average heat production for this entire period of bed rest does not represent the basal, minimum metabolism, but it does represent an energy expenditure that must ultimately be supplied from food. Before considering the true basal metabolism, therefore, it seems advisable to make a study of the data secured in our measurements of the total carbon-dioxide production, and particularly the heat values computed from it.

The actual length of period during which the carbon dioxide produced was collected and absorbed varied somewhat on the different nights, but usually extended from approximately 11.30 P.M. until 6.30 A.M. To simplify matters and make the values more comparable, we have reported only the average carbon dioxide produced by the squad as a whole, per hour. In Table X we have included, in addition to the dates, average ages, weights, heights, and surfaces, the average carbon dioxide produced by each squad as a whole, per hour, and the heat production per 10 hours, first, per individual, then per kilogram of body weight, and finally, per square meter of body surface. Since we are assuming that the average child has 10 hours of bed rest, we have reported these values all on the 10-hour basis. Obviously by a shift of the decimal point the per hour figures can be instantly noted.

Our main problem in studying the heat production of girls was to note the influence of age, and consequently we have recorded our data in Table X on the basis of decreasing average age. Bearing in mind that we are dealing here with average values, in every instance for at least 11 and usually for 12 girls, we see that the average carbon-dioxide produced per squad per hour ranged from 189.3 to 226.9 grams, although but 11 girls appear in the group with

TABLE X.—HEAT PRODUCTION OF GIRLS 12 TO 17 YEARS OF AGE.

Date[1] (a)	Average age (b)		Average body weight (without clothing) (c)	Average height (d)	Average body surface (Du Bois height-weight chart) (e)	Average carbon dioxide produced by squad per hour (f)	Heat (computed[2]) per 10 hours during "bed rest"			Minimum carbon dioxide produced by squad per hour (j)	Basal heat (computed[2]) per 24 hours		
							Per individual (g)	Per kilo. (h)	Per sq. m. (i)		Per individual (k)	Per kilo. (l)	Per sq. m. (m)
1920	yrs.	mos.	kgs.	cms.	sq. m.	gms.	cals.	cals.	cals.	gms.	cals.	cals.	cals.
Jan. 2- 3	17	0	58.1	163	1.62	225.9	581	10.00	359	203.9	1258	21.7	777
Jan. 9-10	15	10	53.6	163	1.57	213.4	549	10.24	350	189.5	1170	21.8	745
Jan. 16-17	14	10	49.9	160	1.51	189.3	531	10.64	352	186.3	1254	25.1	830
April 9-10	14	1	44.2	155	1.39	195.6	549	12.42	395	188.0	1266	28.6	911
March 19-20	14	0	51.7	161	1.52	225.1	579	11.20	381	215.6	1331	25.7	876
Jan. 23-24	13	8	50.0	159	1.49	226.9	584	11.68	392	223.9	1382	27.6	928
Feb. 13-14	13	4	43.7	153	1.37	207.8	535	12.24	391	192.4	1188	27.2	867
March 12-13	12	10	41.0	152	1.33	208.7	537	13.10	404	198.7	1226	29.9	922
March 5- 6	12	2	39.5	150	1.29	199.4	513	12.99	398	191.2	1180	29.9	915

[1] Eleven girls were studied on January 16-17 and April 9-10; 12 girls on all other dates. All girls in the 15-, 16-, and 17-year old groups had reached puberty; none of the girls studied on April 9-10 and March 12-13 had reached puberty; 5 girls on January 23-24, 2 on March 19-20, 4 on February 13-14, and 11 on March 5-6 had *not* reached puberty.

[2] Using a respiratory quotient of 0.79 and 3.086 calories as the calorific equivalent of a gram of carbon dioxide.

the lowest carbon-dioxide production. Since the number in the groups was not always the same, direct comparison between the different groups on the basis of the average carbon dioxide produced per hour is not permissible.

Turning our attention to the average heat production per 10 hours *per individual,* we note that the values range between 513 and 584 calories, with an average of 551 calories. When a finer differentiation is made, however, with the attempt to equalize on the basis of body weight, we note that the range is from 10.00 to 13.10 calories per kilogram per 10 hours, and here we find a distinct tendency for the higher values to appear with the younger and, it should be pointed out, also lighter-weight girls. Computed per square meter of body surface area (Du Bois height-weight chart), the heat production per 10 hours ranges from 350 to 404 calories, the higher values also appearing with the younger girls.

Since a more accurate and satisfactory comparison of the several groups upon the age basis can best be made in the selected periods of quiet, minimum metabolism, further discussion of the 10-hour heat values will not be entered into here. Of prime importance in connection with this series of observations is the fact that the average young girl between 12 and 17 years of age has an energy production during 10 hours of bed rest amounting to approximately 550 calories. To have the caloric needs for 10 out of the 24 hours in the life of young girls of this age range thus definitely established is of very considerable physiological importance.

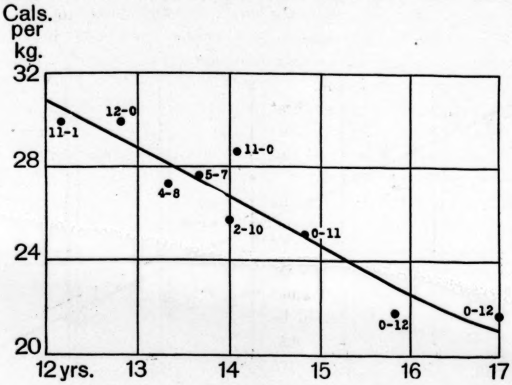
TOTAL BASAL HEAT PRODUCTION.

In this discussion we are primarily interested in the total heat production, as it is this factor which must be taken into consideration in computing the average energy needs of young girls. As a result of our measurements we have data for computing the average basal heat production of nine groups of young girls, ranging in average age from 12 to 17 years, in average weight from 39.5 to 58.1 kgs., and in average height from 150 to 163 cms. The minimum heat production per individual computed on the 24-hour basis (shown in column *k* of Table X ranges from 1170 to 1382 calories, averaging 1251 calories. At first sight, when one considers the differences in age, in height, and particularly in weight, the approximation to uniformity in this average figure of 1251 calories is astonishing, to say the least, and the deviations therefrom in the different groups are surprisingly small. Thus, the lowest value is but 81 calories below the average and the highest but 131 calories above, and it would almost appear as if the heat production of these different groups of girls was utterly independent of the age, weight or height. For general purposes of computation, therefore, where large groups are involved, the use of a round figure of 1250 calories to represent the 24-hour basal heat production of the average girl between 12 and 17 years of age would be thoroughly justified. Since with adults, as stated above, four factors at least influence basal metabolism, namely, sex, age, height, and weight, further consideration should be given to these energy values for girls, in which the attempt should be made to rule out variations due to weight.

BASAL HEAT PRODUCTION PER KILOGRAM OF BODY WEIGHT REFERRED TO AGE AND WEIGHT.

The simplest method of securing a uniform basis for the comparison of the heat production of individuals of various sizes is that long-established one of computing the metabolism per kilogram of body weight. Of course this method does involve the rather broad assumption that each kilogram of body mass has the same heat-producing power. With obese subjects this is a particularly erroneous assumption. Still, with our groups of girls, who are not characterized by extreme emaciation on the one hand, or obesity, on the other, the comparison may be legitimately made. Accordingly we have computed the values for the basal heat production per kilogram per 24 hours, and have recorded them in column *l* of Table X, also in the order of decreasing age. When we consider the total heat production per individual per 24 hours, we find a rather close agreement throughout the entire series, but considering the heat computed per kilogram of body weight we note a tendency for the values to deviate considerably. The lowest value is 21.7 calories per kilogram and the highest is 29.9 calories. With reference to age it can be seen that here we are dealing with the distinct evidence of a higher heat production per unit of body weight the younger the girl, the age element here being a very pronounced factor There is a reasonably uniform tendency for the

FIGURE 2.—BASAL HEAT PRODUCTION OF GIRLS PER KILOGRAM PER 24 HOURS REFERRED TO AGE.



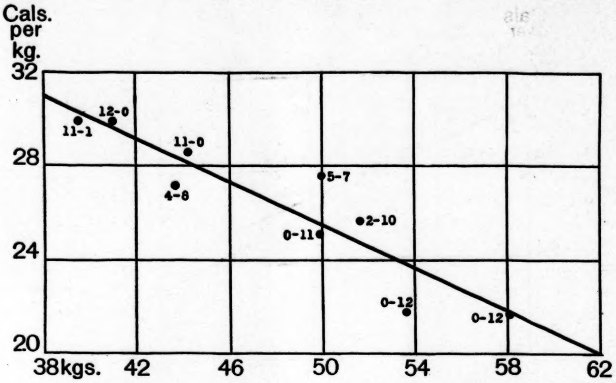
The first of the two figures accompanying each point on this and the following charts represents the number of girls in the group who had *not* as yet menstruated; the second figure indicates the number who had.

values to decrease regularly with increasing age, the most marked exception perhaps being noted with the group on April 9-10, aged 14 years, 1 month.

This relationship between the age of the several groups and the heat production per kilogram of body weight is perhaps best shown by a chart. Accordingly in Figure 2 we have plotted the calories per kilogram referred to age, and have drawn through these points the line representing, in the judgment of five individuals, the most probable trend of the metabolism. An inspection of Figure 2 shows that there is a reasonably uniform tendency for the heat per kilogram to decrease with increasing age. The most noticeable deviation from the slightly curved line, arbitrarily laid on this chart, is that of the group aged 14 years, 1 month, noted above, which exhibits a metabolism higher than that indicated by the curve. Of special importance, therefore, in the comparison of the age with the metabolism under conditions of computation where the differences in body weight are presumably ruled out or at least minimized, is the fact that a specific, high metabolism for the lower ages is very evident. The fact that the general trend can best be expressed by a line so nearly straight does not speak for any pronounced irregularities in the metabolic trend of girls between the ages of 12 and 17 years.

While at first sight it would appear as if the computation of the heat production per kilogram of body weight removed practically all influence of body weight itself in the comparisons, it has been seen with younger children, at least, that the heat production per unit of body weight varies greatly, although it is very difficult with children, where age and weight changes are so pronounced, to differentiate sharply between the influence of age *per se* and weight *per se* upon heat measurements on any computed basis, even that of the heat per kilogram of body weight. Still, in examining the data in column *l* of Table X, we find that a distinctly high value appears for the age group of 14 years, 1 month, namely, 28.6 calories per kilogram. The question may be asked, "Is this high value due to the influence of age or is it due to the fact that we are dealing here with a group of physically smaller girls, both in weight and in height?" It will be necessary, therefore, to consider the heat production per kilogram of body weight with changing weights rather than ages, and this comparison has been made in Figure 3. Nearly all the points lie very close to the straight line indicating the general trend. The rather wide deviation from the line noted in Figure 2 for the group aged 14 years, 1 month, *i.e.*, 44.2 kgs., here disappears, the 50.0 and the 53.6 kilogram groups now showing the widest deviation, which in this comparison is proportionately somewhat greater than that shown by the 44.2 kilogram group on the age basis. In column *l* of Table X it can be seen that the value

FIG. 3.—BASAL HEAT PRODUCTION OF GIRLS PER KILOGRAM PER 24 HOURS REFERRED TO WEIGHT.



of 28.6 calories lies between 25.1 and 25.7 calories, but if this table were re-arranged on the basis of decreasing body weights instead of decreasing ages, the value of 28.6 calories would appear among the lower weights, and hence properly grouped with the higher per kilogram figures. While the general trend of values in column *l* makes it very evident that we are dealing here with a higher heat per kilogram of body weight with the younger girls, we must recognize the fact that with rapidly growing organisms it must not be assumed that computing the heat production per kilogram of body weight rules out the influence of body weight *per se,* and the facts that we have noted in connection with the 14 years, 1 month old group, with a small body weight of 44.2 kgs., distinctly lend credence to the belief that the influence of *body weight* affects computations even on the basis of per kilogram of body weight. It is of special significance that the two groups at 16 and 17 years, with an average body weight of 55.9 kgs., should have a heat production of 21.7 calories per kilogram, while the two youngest groups, likewise having the two lowest body weights, show identical values of 29.9 calories, *i.e.,* an increase in the heat production per unit of body weight amounting to 8.2 calories or somewhat over 37 per cent.

BASAL HEAT PRODUCTION PER UNIT OF BODY SURFACE REFERRED TO AGE AND TO WEIGHT.

As has been shown in earlier researches, changes in body surface area represent more nearly the general morphological law of body growth than do changes in body weight. Therefore it is important particularly in the period of rapid growth to compare the metabolism under all measurable conditions. Thanks to the studies of D. and E. F. Du Bois,[7] we may now speak intelligently and accurately of the body surface area of humans. Without assuming the existence of a "law" relating to the loss of heat in proportion to surface area, we may compare the heat production of our different groups of girls to their surface areas. In column *m* of Table X are given the values for the heat production computed per square meter of body surface per 24 hours. The values range from 745 calories with the group 15 years, 10 months old to 928 calories with the group 13 years, 8 months old, the average value for the entire series being 863 calories per square meter. Thus we see that the lowest value is 118 calories below the average and the highest is 65 calories above. There is, furthermore, a distinct tendency for the higher values to appear with the younger ages, although the group aged 13 years, 4 months, exhibits a relatively low metabolism. The values for the heat per square meter referred to age have been plotted in Figure 4. Here there is a very definite indication of a marked slope to the line which would represent the general trend of all observations.

Recognizing that girls of the same age or, indeed, groups of girls of the same age, may differ very considerably in body weight and that even computing the heat per square meter of body surface may not rule out factors other

Fig. 4.—Basal Heat Production of Girls per Square Meter of Body Surface per 24 Hours Referred to Age.

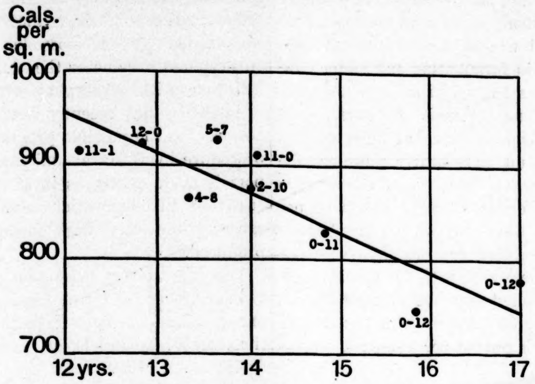
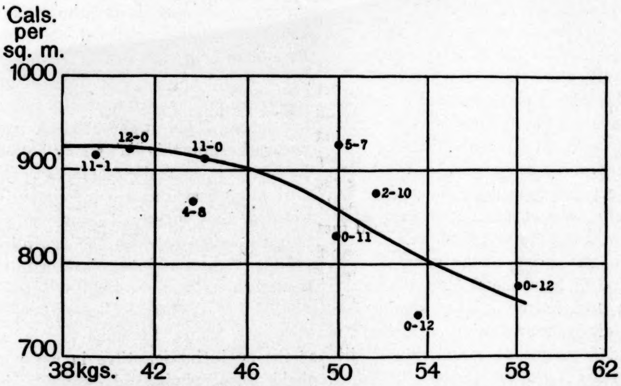


Fig. 5.—Basal Heat Production of Girls per Square Meter of Body Surface per 24 Hours Referred to Weight.



than age, we deem it of value to note the calories per square meter of body surface referred to weight. This comparison has been made in Figure 5. On the basis of weight there is a wider scatter of individual points than on the age basis; but nevertheless there is a distinct tendency here for the lighter weight children to have the higher metabolism per square meter of body surface.

Such charts as Figures 2 to 5 illustrate even more clearly the difficulty of dissociating the weight element and age element in this rapid period of growth. It is clear from the data in column *m* of Table X and from Figures 4 and 5 that the heat production per square meter of body surface with these girls may not be looked upon as a physiological "constant." In examining these several charts one must again be reminded of the fact that each point represents the average of a group of 11 or 12 girls.

The popular conception of a uniform heat production per square meter of body surface certainly finds no proof with these groups of Girl Scouts. Indeed, the deviation of the minimum and maximum either side of the mean shows that with these groups at least there is a slightly better degree of uniformity in the *total* calories per 24 hours, as shown in column *k* in Table X, than there is in the heat production per square meter of body surface, as shown in column *m*. It is clear, therefore, that the relative uniformity noted in the total heat production per 24 hours, the continually decreasing calories per kilogram of body weight accompanying increasing age and particularly increasing weight, and the decreasing calories per square meter of body surface accompanying increasing age and weight, must all be taken into consideration in formulating any method for predicting the basal metabolism of young girls. So far as any one factor is concerned, it is clear that the average value of 1250 calories per 24 hours would more nearly represent the true heat production than would the average value for per kilogram of body weight or per square meter of body surface. Without these two latter methods of analysis, however, one would fail completely to note the specific high metabolism associated with the younger ages, a physiological fact of fully as great significance as the total caloric output per 24 hours.

THE PREDICTION OF BASAL METABOLISM.

The prediction of the basal metabolism of groups of individuals is of value in the computation of their dietetic needs, since the basal metabolism represents the 24-hour irreducible minimum. With the present-day extraordinary interest in studying basal metabolism, it is important to have some approximation to a normal or standard with which individual measurements may guardedly be compared. The Nutrition Laboratory has repeatedly emphasized the fact that there is no standard normal metabolism from which normal individuals do not vary. But a knowledge of the general, most probable trend of basal metabolism is of great physiological and, indeed, clinical significance. The present study, representing as it does the data obtained from groups of individuals, differs considerably from all earlier studies of basal metabolism, and these values, owing to the nature of their determination, may properly be used to indicate the average normal trend.

(To be continued.)

◆

A NOTE UPON THE PRODUCTION OF AGGLUTININS IN TYPHOID FEVER.

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The value of frequent estimations of the agglutinin titre of the blood in typhoid fever is sufficiently well recognized to need no further comment, particularly in these days when the interpretation of agglutination reactions is complicated by the possible previous use of anti-typhoid vaccine or the occurrence of mixed infections with paratyphoid strains.

Attention has recently been again directed, however, to the possible prognostic value of the procedure by O'Hara[1] and the present case report is made partly as in a small way corroborative of his observations, and particularly because of the very high amount of agglutins produced.

The quantitative estimation of agglutinins in typhoid fever is by no means a new performance: indeed, it dates from the first investigations of Widal and is, or should be, the foundation upon which rests the diagnostic interpretation of the test. Nevertheless, while the exact titre which may be obtained in the laboratory immunization of animals is a matter of frequent notation, parallel observations upon the human being are not so frequently obtained and it would appear that titres of over 1:80 or 1:200 are either infrequently encountered or not noted. This apparent lack of accessible observations on this point may be due partly to the fact that, once the diagnosis is obtained, agglutination reactions are infrequently or rarely repeated, and, partly, because no relation apparently exists between the agglutination titre and the process of immunization in the patient. Nevertheless, it would seem of interest, and, in the light of O'Hara's observations, of possible prognostic value, to make regular estimations of the agglutination titre in every case of typhoid, paratyphoid and dysentery infection.

With regard to the possible technique, there is no question of the superiority of the macroscopic over the microscopic methods from the standpoint of accuracy, delicacy, and availability for general use; and, in the case of mixed infections, the macroscopic method is the only one possessing diagnostic value.

In these laboratories a formalinized suspension of typhoid, and of paratyphoid bacilli in 0.85% NaCl solution is used as the antigen in a dose of 0.5 c.c., all dilutions of serum being made by pipette graduated in 1/100 c.c. There is no objection, however, to making the dilutions in drops with a dropper after the manner of the standard Dreyer technic. Incubation is in a water bath for one hour at 50° C., followed by the ice-box at 4°-9° C. over night.

Each serum is set up against typhoid, para A, and para B strains and a known serum included to ensure the agglutinability of the suspensions used. The usual controls to guard against spontaneous agglutination, etc., are always included.

The case report follows:

John M., aged 10; serial number 9429-A; medical number 2534, was admitted to the Pittsburgh Hospital July 15, 1920. Chief complaint, headache. Family history, unimportant. Past Medical History—In 1918, had scarlet fever complicated by an otitis media, which eventually led to a double mastoid operation. Ever since the operation there has been a discharge from the ears, the dressings being done by the mother at home. Present Illness—The patient made no complaint until eleven days before admission, when there was severe headache. Following the use of a laxative, this was improved. The following day, however, he had a chill accompanied by a return of the headache and some nose-bleed. On the day of admission he had a marked fever. Physical examination on admission showed a well-developed boy, somewhat anemic in appearance, in a semistuporous condition. The teeth showed sordes and the lips a herpetiform eruption. The physical examination was otherwise negative. Admission temperature, 104; pulse, 140, shortly dropping to 110.

The subsequent course of the case was one of increasing toxemia, the mental condition ranging from stupor to delirium. On the 28th, the entire body was covered with purpuric spots, a condition which gradually increased until, on the seventh of August there was a profuse hemorrhage from the bowels. The temperature ranged from 104 on admission to 97 on the day of death.

Laboratory Findings—July 16, urinalysis: acetone, diacetic acid, and albumin present, with diminished chlorides; numerous hyalin and coarse granular casts in the sediment. Blood—Hemoglobin (Dare) 75%; RBC 4,020,000; WBC 6,200. Agglutination tests negative. July 17—Pus from the ears gave growth of staphylococci and a small bacillus of Hoffman type. July 21—Blood culture—recovered B. typhosus. July 26—Agglutination tests positive with para B. strain in 1; 80, with B. typhosus in 1:1280. August 2—WBC 7,250. Agglutination tests positive with B. typhosus in 1:640. August 4—Agglutination tests positive with B. typhosus in 1:60. August 7—Died.

The case is of interest both on account of the high agglutinin production and because the falling titre seemed of some value as indicating the subsequent clinical course. It would also, apparently, indicate the advisability of frequent and regular estimations of the agglutinins which could readily be charted like the pulse and temperature.

I am indebted to Dr. C. J. Devlin for the opportunity of utilizing the case for this report.

REFERENCE.

[1] O'Hara: Observations on the Agglutinating Titre of the Blood Serum in Typhoid Fever. Boston Medical and Surgical Journal, Vol. clxxxiii, No. 3, pp. 77-80, July 15, 1920.

Clinical Department.

ACUTE EMPYEMA COMPLICATED BY WHOOPING COUGH.

Rib Resection and Valve Drainage of the Chest under Local and Paravertebral Anesthesia.

By William Reid Morrison, M.D., Boston.

An interesting case of empyema following lobar pneumonia, and at the same time suffering from pertussis in the acute stage, was seen by the writer in a little girl two years and five months of age.

Personal History—E.V.M. was referred to the author by Dr. E. S. Boland of South Boston. Family History—Mother is living and well; has had no miscarriages. Father and three brothers are alive and well. Past History—The patient was born normally, and was breast fed until fourteen months old. She had lobar pneumonia two weeks or more, previously, lasting ten days. Present Illness—Mother has noticed rapid respiration, fever, malaise, and recurrent paroxysms of coughing and vomiting. Physical Examination—The patient was fairly well developed and nourished, and conscious. She was pale, and showed great prostration, with marked dyspnoea while sitting up; she could not lie down. Her temperature was 100.5, her pulse 120; her respiration was 46. The head and neck were negative. Chest—Left side was flat on percussion throughout. Vocal and tactile fremitus were absent. There was distant bronchial breathing. Aspiration of left chest, with needle and syringe, in the seventh interspace in the posterior axillary line revealed the presence of thick white pus, odorless. Dr. F. B. Mallory subsequently reported the organisms to be type one pneumococcus. Respiratory movements on the left were diminished. Her right chest was resonant, with exaggerated breathing. Grocco's sign, paravertebral dullness was present; the chest was otherwise negative. The heart was displaced markedly to the right; action was rapid, regular. There was no enlargement, no murmur. No x-ray examination of the chest was made. Abdomen, genito-urinary, skin, bones and joints, glandular, and neuro-muscular examinations were negative.

The parents of the patient refused adequate hospital treatment, as they considered the case hopeless. A poor prognosis was given the parents, because the patient's resistance had already been lessened by lobar pneumonia. The subsequent infection of the pleural cavity increased the prostration, as she was absorbing the poisonous toxins from a chest full of pus. Her heart and mediastinum were pushed to the right by the presence of the fluid, embarrassing her functioning right lung.

An operation at home, under novocaine anesthesia, was therefore advised and accepted. Morphine sulphate, one thirty-second of a grain, was given subcutaneously, one-half hour before operation. Benzine and half-strength tincture of iodine were used for the skin preparation. In a well-heated room, the child was wrapped in warmed blankets, and placed in a half-sitting position. Novocaine solution, one-half of one per cent., was injected locally, and paravertebrally. An incision eight centimeters long, was made parallel to, and over the ninth rib, in the posterior axillary line. The soft tissues were incised down to the rib, and were retracted upwards, then two centimeters of the eighth rib were resected subperiosteally. The pleural cavity was opened, and over a quart of pus and much detritus was allowed to escape slowly. The lung expanded fully after the patient coughed, the soft tissues acting as an efficient valve. A small drainage tube of rubber, the width of the chest wall in length, and one and one-half centimeters in diameter, was sutured to the inferior wound margin with interrupted silk-worm gut mattress sutures. The superior wound edge was sutured loosely over the tubing to the inferior margin, preventing air going in and out of the chest, and allowing free drainage. A dry sterile dressing and swathe were then applied. There was no hemorrhage and practically no shock following the operation. The general condition of the patient was poor.

During convalescence, the child was placed in a sitting position on pillows, small amounts of milk, and later, egg-nogs, were given as often as possible without causing nausea. Much nourishment was, of course, lost, because of the paroxysms of coughing and vomiting. Four days after the operation, the dressing was changed, and the sutures and tubing removed. There was considerable drainage of pus. The patient's general condition improved, the wound was dressed daily for three weeks; at the end of that period the drainage had stopped. The wound granulated in slowly, and healed three weeks later.

Ten months afterwards, the child was examined. Her chest expansion was symmetrical, there was no deformity present, as she could fully extend both arms above her head, and in all directions. New rib had grown into the bony defect, and her chest was otherwise negative. Her weight was thirty-eight and one-half pounds. She had measles a few months previously, otherwise she had been in excellent health.

CONCLUSIONS.

1. In such complicated infections of the chest, novocaine is the anesthetic of choice, injected locally and paravertebrally. Ether, chloroform, or other general anesthetics are distinctly contraindicated.

2. An indirect opening into the pleural cavity is infinitely preferable to a direct one, because in the latter case, air rushes in and out of the chest continually, with each respiration. This causes partial lung collapse, which, in turn, favors cavity formation and chronic empyema, as the lung cannot fully expand.

3. A valve fashioned from the soft tissues themselves is more efficient than any mechanical valve.

Medical Progress

RECENT PROGRESS IN NEUROLOGY.

By ISADOR H. CORIAT, M.D., BOSTON.

ORIGIN AND NATURE OF MULTIPLE SCLEROSIS.

Two theories have been utilized to explain multiple sclerosis: first, that the disease is a vascular disorder of inflammatory origin, and secondly, that it is produced by an infectious agent. Marinesco (*Revue Neurologique,* June, 1919) is of the opinion that the nerve lesions are secondary to the vascular. The sclerosis is localized more in the white substance than in the gray, and in the white substance there is an overgrowth of neuroglia. It is only in the acute cases that the nerve cells are actually affected. There is a marked perivascular inflammation, principally by lymphocytes, plasma cells and mastzellen. Polynuclears and eosinophiles are rare. Rod cells also may be present, a feature which shows the relationship of this disease to neurosyphilis and paresis. As there may be a ventricular inflammation, the cerebrospinal fluid may contain the pathogenic elements of the disease. The disease is not of syphilitic origin, either clinically, histologically or serologically. Some writers have described a spirochete in the blood and cerebrospinal fluid of the disease. The transmissibility of the pathogenic agent of multiple sclerosis through injection into animals of the cerebrospinal fluid from subjects having the disease, has been confirmed by several investigators, and in rabbits there could be produced a motor disorder with death from paralysis. The blood of these injected animals has shown the presence of a spirochete.

In Marinesco's experiments the cerebrospinal fluid from two subjects having typical multiple sclerosis, was injected into six guinea pigs by the intradural, intracerebral and intraperitoneal routes. In the two intradural cases, there developed three or four days after the injection, motor disorders and weakness of the limbs. The cerebrospinal fluid in these cases showed a large number of active spirochetes by means of the ultra microscope. In the injections by other routes no symptoms were produced and the presence of spirochetes could not be demonstrated.

(While these experiments of Marinesco are not convincing, yet they are a step in the right direction, provided one is inclined to accept the infectious origin of the disease. A definite position on this latter cannot be taken, but since multiple sclerosis is a disease of adolescence or young adults, it appears that Adler's conception of organ inferiority, when applied to the central nervous system may explain the puzzling etiology of this disease. The disease is not syphilitic in origin, as the Wassermann reaction in the blood and spinal fluid are negative, and the cell count within normal limits.)

TREATMENT OF CAUSALGIA.

Lewis and Gatewood (*Journal American Medical Association,* Vol. 74, Nov. 1, 1920) call attention to one of the most distressing complications or sequellae of peripheral nerve lesions. It was first observed by Weir Mitchell during the Civil War. Its predominant feature is persistent pain, probably due to an ascending neuritis in the injured nerve. Four cases were observed among 550 cases of peripheral nerve injuries. Three of these patients were operated on and cured by intraneural injections of 60% alcohol. These injections seem to interrupt the conduction of sensory impulses, but do not interfere with transmission of motor impulses; the motor palsies, when they do develop, are transitory and show rapid recovery.

WOUNDS OF THE CEREBELLUM.

This interesting and remarkable monograph, by André Thomas (1918), deserves a more extended notice than can be given within the limits of an abstract, as it shows the results which may be obtained in neurology by sound and thorough clinical observation. With Tinel's "Nerve Wounds," it will remain as one of the outstanding French contributions to the neurology of the war and upholding the best traditions of the neurology of the French school. Only three cases were studied, but the cerebellar wounds in each were so localized as to make the conditions comparable to the experimental destruction of the cerebellum in animals.

These three cases were made the subject of extended and careful clinical observations, not only by means of the usual tests for cerebellar lesions and for disturbances of equilibrium, but the monograph is illustrated by excellent moving pictures of the application of the various tests for muscle tonus, ataxia, and passive and active muscular movements.

In a study of the knee-jerk on the affected limb, on the side of the lesion, the author points out that the leg, instead of immediately returning to its condition of repose, tends to remain hyper-extended in a series of oscillations. The same phenomenon has been seen in chorea and when we recall how often chorea resembles a cerebellar lesion, the analogy is interesting if not altogether convincing. It was shown that the adiokokokinesis test, on which Babinski lays so much stress, is characterized by the rapidity of certain movements and the slowness of others, and that dysmetria plays an important part in the phenomenon. All the cases showed a defective association of muscular movements known as asynergia. Nystagmus existed in all the cases.

After a long discussion of the normal and pathological physiology, the relation of Barany's work to cerebellar lesions, and the data of cerebellar localization, the following conclusions are drawn: The symptoms in these three cases studied were the same, but of different distribution, according to the nature and site of the lesion. All the symptoms were homolateral. The nearly complete inertia of one of the lower limbs in one of the cases and the fact that one of the upper limbs was involved, is a proof of definite cerebellar localization. In two cases, the disorder of equilibrium disappeared when the lesion was at a distance from the vermis, while in one case the disturbance of equilibrium persisted when the vermis was involved, a most convincing proof of the importance of this region in the regulation of the equilibrium and attitude of the body. There could be determined the existence of special centres for muscular movements, the same as in animals where the cerebellum has been partially destroyed.

EPIDEMIC ENCEPHALITIS.

Three papers on this interesting disease by Bassoe may be considered together. The first paper (*Journal American Medical Association,* April 5, 1919) gives in detail the clinical histories of twelve cases, in two of which complete autopsies were performed. The brain changes were very similar in each case. The gross changes consisted mainly of oedema, congestion and minute hemorrhages, most numerous in the brain stem, basal ganglia and centrum ovale. The histopathological changes consisted principally of dense accumulations of mono-nuclear cells around the vessels and of small hemorrhages. Outside of the classical symptoms, certain anomalous clinical features were noted, such as muscular rigidity and slow movements resembling katatonia and advanced Parkinsonian rigidity, and a sort of pseudocerea flexibilitas. The early occurrence of lethargy points to its being a focal symptom rather than an expression of intoxication of the higher brain centres. A careful study of the symptoms and lesions of this disease may help to throw a valuable side light on such disorders as paralysis agitans, chorea, Wilson's disease (progressive lenticular degeneration) and perhaps even dementia praecox. The spinal fluid showed a slight increase in monoculear cells. Cultures of the blood and spinal fluid were negative. The second paper by Bassoe and Hassin (*Archives of Neurology and Psychiatry,* July, 1919) is devoted exclusively to the histopathology of the disease. The following conclusions are drawn:

1. The pathologic changes in epidemic (lethargic) encephalitis involved the entire central nervous system.
2. These changes are both parenchymatous and interstitial.
3. The former principally involved the cortex, the latter the peduncles, internal capsule, lower pons, bulb and cord. In the basal ganglia and midbrain both parenchymatous and interstitial changes are pronounced.
4. In its histopathology epidemic (lethargic) encephalitis differs from the various types of hemorrhagic encephalitis, but it is identical with that of African sleeping sickness (trypanosomiasis).
5. It differs from typical cases of paralytic dementia by the topography of the lesions and by the absence of vascular wall changes which are probably due to the more chronic course of the latter.
6. It also differs from the various types of traumatic and experimental encephalitis and from acute anterior poliomyelitis.
7. It is pathologically a distinct morbid entity, a disease *sui generis,* and does not resemble the conditions previously described as influenzal encephalitis.
8. The similarity between the pathologic changes in African sleeping sickness and epidemic encephalitis suggest a close relationship of their etiologic factors, that is, the epidemic encephalitic may be caused by a parasite akin to a trypanosome. In Bassoe's third paper (*Journal A.M.A.,* April 10, 1920) cases are reported in which the characteristic lethargy is lacking. On the contrary, symptoms akin to a general infection, suggestive of typhoid or acute miliary tuberculosis, or even to a severe acute chorea, were observed. Among the new symptoms the twitching of the abdominal muscles were also observed. Focal symptoms, such as aphasia and transitory hemiplegias were seen in some cases, while pain in the extremities was a marked feature in other cases, the latter probably produced by meningeal irritation or by irritation referable to the spinal or cranial nerve roots.

The mental disturbances in lethargic encephalitis are discussed by Abrahamson (*Journal Nervous and Mental Disease,* Sept., 1920). In the somnolent state, the answers are short but coherent and show no loss of either memory or orientation. After a reply, the somnolent state is resumed. Requests for single movements are obeyed, but there follows a relapse into the somnolent immobility. The somnolence gradually disappears and is followed by a period of mild depression. Sometimes the somnolence may deepen into a stupor. There is complete lack of emotional expression, the features are mask-like, and the muscular symptoms of a katatonic stupor may make their appearance. Sometimes the stupor state may pass away and leave a confusion, disorientation, and a memory disorder of the Korsakoff type. We are practically ignorant of what passes in the trance of lethargic encephalitis, as what is disclosed of it is usually too fragmentary for analysis.

(So many features of a negativistic stupor enter into the mental state of the lethargic encephalitis, that in young people there is frequently great difficulty in differentiating the condition from dementia praecox.)

LUMINAL IN EPILEPSY.

Julius Grinker (*Journal American Medical Association*, Aug. 28, 1920) summarizes his experiences on the therapeutic value of luminal in epilepsy as follows:

Luminal in small doses, from 1½ to 2 grains, once or twice daily, has been found capable of causing an arrest of convulsions in epilepsy.

Larger doses than those mentioned are seldom required, but may be safely given.

Larger doses may be administered when beginning treatment, especially after sudden withdrawal of the bromide treatment; even in such cases, the dose may be gradually reduced to what constitutes an average dose, namely 1½ to 2 grains.

No harmful effects have thus far been observed from the long-continued administration of the drug.

It does not appear to be a habit-forming drug.

The effect on the mentality of patients taking luminal for epilepsy was surprising. Patients receiving average doses of luminal do not show the peculiar mental torpor of those taking bromides.

(Of course the antispasmodic action of luminal is merely symptomatic in either reducing the convulsions or causing them to cease. Even after the convulsions in epilepsy have been controlled, this does not cure the disease; for the essential character make-up of the epileptic remains and the definite conflicts which precede the seizure episodes may be still present.

The best-treatment of so-called essential or idiopathic epilepsy is a combination of the dietetic-hygienic regimen, plus the analytic reeducation of the patient from the standpoint of the character traits of the individual patient.)

TRAUMA IN PARESIS.

Under the title of "Trauma and other Non-Luetic Influences in Paresis" (*Journal Nervous and Mental Disease*, Aug., 1920), Osnato enters at length into a subject of great importance, particularly from the medico-legal standpoint. After reviewing the various authorities on the subject, both before and since the specific serology of paresis was definitely known, he draws the following conclusions:

1. There are undoubted acute and chronic pathological lesions of the brain ascribable to trauma of the head with or without injury to the vault or base of the skull. The early results of the injury are due to hemorrhage and laceration or destruction and edema of the brain tissue; the latter results are due to gliosis and sclerosis of the nerve cells. These latter pathological changes produce the so-called traumatic insanity. The earlier symptoms produce focal paralytic lesions or simple concussion.

2. The symptoms and pathology of traumatic insanity are similar in some degree to those of paresis. This statement refers more particularly to the memory and intellectual defects and the pathological reaction of the ectodermal elements of the brain.

3. It appears from the evidence submitted above, that cerebral syphilis of the paretic type develops when something happens to change the permeability of the blood vessels of the brain, thus allowing the spirochetes and their toxins access to the brain tissue. Trauma of the brain may, therefore, by causing vascular injury or brain destruction, be followed later by gliosis and nerve-cell sclerosis, allowing first the spirochetal invasion, and later adding to the gliosis and sclerosis of nerve cells which also are an integral part of the paretic brain pathology.

4. It would appear from clinical cases submitted, that certain cases of paresis have been acutely precipitated and others adversely influenced by cranio-cerebral injury.

5. Other toxic disturbances, such as the toxins of influenza infections, alcohol and ether, may have an influence similar to trauma in the production of precipitation of paretic neurosyphilis in an individual already suffering from cerebral or general syphilis.

6. The question of the effect of emotional stress and bodily and mental fatigue on the production of precipitation of paresis must be left for further investigations.

7. The responsibility of any given injury to the head occurring in a non-paretic syphilitic must be absolute if the paretic signs follow the injury and disable the patient soon after.

8. In order to lay the responsibility for such an occurrence upon any given injury, it is impossible to use the period of latency as an absolute criterion of responsibility, because even in ordinary traumatic insanity, this period during which the pathological processes are occurring which are responsible for the later chronic mental symptoms, may be indefinitely prolonged.

9. It would appear to be indicated that any

syphilitic suffering from a trauma to the head, with possible cerebral injury, should immediately be given prolonged rest and active intensive anti-syphilitic treatment with a view to killing as promptly as possible any spirochetes which may have gained entrance to the brain substance. In order to favor the production of this result, the anti-syphilitic treatment should be begun immediately after consciousness is recovered and acute symptoms of shock due to the injury have disappeared.

10. One must be prepared for a possible paretic reaction following infections and prolonged etherization in a known syphilitic.

Book Review.

George Miller Sternberg: A Biography. By Martha L. Sternberg. Chicago: American Medical Association. 1920.

In the publication of this biography of General George Miller Sternberg, written by his wife, Martha L. Sternberg, with an unusual grace and charm of literary style, the American Medical Association has made available for the profession, a book of especial historical and scientific interest. The story of Dr. Sternberg's life and achievements records a noteworthy episode in the history of medicine, that of the conquest of yellow fever, the successive stages of which were taken up in turn by three medical officers of the United States Army,—the first, General Sternberg, followed by Walter Reed and General William C. Gorgas. The biography narrates incidents in Dr. Sternberg's early life and records his activities in the Civil War, his subsequent studies and experiences in civil and military life, and his work in scientific research.

Dr. Sternberg entered the Army in 1861 as a surgeon with the Union forces, and served throughout the Civil War and in the Indian campaigns, notably the Nez Perces War. In the course of his tours of duty at eastern and southern military posts, he acquired valuable experience in combating cholera and yellow fever. He was the pioneer in bacteriology in the United States; he discovered the pneumococcus in 1880, and was the first in this country to demonstrate the organisms of malaria, cholera, and tuberculosis. The practice of modern disinfection is based on Dr. Sternberg's researches on the value of commercial disinfectants, the study of which he began in 1878 at an isolated frontier army post. Under the same inauspicious surroundings he also invented a heat regulator, modified and elaborated forms of which are today in general use for the thermostatic control of heating apparatus.

As Surgeon-General, Dr. Sternberg directed the medical activities of the Army during the Spanish-American War, founded the Army medical school, organized the nurse corps and the dental corps and established many military hospitals throughout the United States, including the tuberculosis hospital at Fort Bayard. By the establishment of laboratories and by personal encouragement, he inspired medical officers of the Army to engage in research. Many scientific investigations were conducted during his term as Surgeon-General, the most important of which related to tropical diseases, typhoid fever, and yellow fever. During the Spanish-American War he recommended the appointment of the Typhoid Fever Board composed of Major Walter Reed, Major Victor C. Vaughan, and Major Edward O. Shakespeare, and suggested the searching investigation of typhoid fever in the military camps which led to the formulation of adequate measures of prevention.

From the time of his first experience with yellow fever at Governor's Island, New York Harbor, Dr. Sternberg's interest in the subject never abated. He fought several epidemics of the disease in the cities and military posts along our coast and, himself, suffered a severe attack of the disease. He was a member of the first Havana Yellow Fever Commission, the appointment of which was the immediate outcome of the wide prevalence and great mortality of yellow fever in 1878, and he made exhaustive studies of the disease in Cuba, Mexico, Brazil, and other tropical countries. One of the most brilliant discoveries in the history of medicine resulted from his appointment of the Yellow Fever Board, under Major Walter Reed, in May, 1900, which by human experimentation proved conclusively that yellow fever is transmitted by mosquitoes. The practical application of this discovery resulted in the eradication of yellow fever from Havana and contributed to the successful building of the Panama Canal.

After his retirement from the Army, Dr. Sternberg devoted his efforts primarily to the improvement of housing conditions among the laboring classes in Washington, and to the prevention of tuberculosis. He was the author of a manual of bacteriology and of several other works on malaria, immunity, serum therapy and infection. Dr. Sternberg was the recipient of many honors during his lifetime, among which was his election in 1897 as president of the American Medical Association. This biography records the achievements of a leader among American physicians, of a pioneer among American army surgeons in the study of bacteriology, of a man whose clear thinking, devotion to duty, and untiring industry made possible some of the most significant discoveries in the history of medicine.

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BRIEF SUMMARY OF THE ANNUAL CONGRESS IN CHICAGO.

The annual congress in Chicago March 7, 8, 9, and 10, for the consideration of the problems relating to Medical Education, Licensure, Hospital Service and Health, was attended by a Delegation on Medical Education, Council on Health and Public Instruction, The Association of American Medical Colleges, the Federation of State Medical Boards, and The American Conference on Hospital Service.

The greatest interest was concentrated on the development of specialists by the courses conducted by the medical schools, and the relation of the work of specialists to that of the general practitioner. Generalized summaries of the problems involved, were presented by Dr. Arthur Dean Bevan and Dr. Frank Billings. It was evident that the questions involved are important and have led to a degree of unanimity among the leaders of the profession. Both Dr. Bevan and Dr. Billings spoke clearly and positively of the necessity of maintaining the function and dignity of the well-trained general practitioner and that the training of the specialist should not be only for the development of the best service of the people, but also to promote cordial and coöperative relations with the general practitioner. It was estimated that, taking for example a community of one thousand people, ninety per cent. of the medical service should be rendered by the general practitioner and that in order to equip him for the work, the medical schools should concentrate more largely in carefully instructing students in the fundamentals of general medicine, general surgery and obstetrics, and further, that during the regular medical course of four years, the student's mind should not be overburdened by requirements involving the expenditure of much time on specialties. Rather that he should acquire a broad general conception of medical practice and have a thorough training in the application of standardized procedure. One very significant statement was made that the teaching of obstetrics in the average medical school was inadequate and alarm was expressed that, unless an occasional survey both of the aspect of the profession and the needs of the people, and as a result of this survey false quality and quantity of service corrected, the tendency to State Medicine would grow.

The profession was advised to meet this implied demand and the suggestion offered that, unless the profession enters the study and provides the remedy, the public will do so.

If there is foundation for this contention, the challenge is a real one. There is a suspicion amounting almost to conviction upon the part of those whose interest has been aroused, that the profession is on the defensive. It has never organized, and one may be pardoned for intimating that up to the present time there has not been shown constructive and coördinating criticism of the subjects offered for the better service of the people. There was a concurrence of opinion that the medical schools should postpone teaching of specialties until after the completion of the regular four years' course, lest the allurements of spectacular exhibitions dissipated the interest of the student in fundamentals; and, furthermore, that the teaching of specialties should be sufficiently thorough to lead to the elimination of the pseudo-specialist often recruited from the ranks of the general practitioner. Such men sometimes learn the technique of a simple operation and then blossom out as specialists without having studied the pathologic, associated tissue and functional changes, and hence are inadequately equipped to be of real assistance to the general practitioner.

It was generally agreed that there are two classes of men who can be developed into specialists: first, the graduate who enters upon the study of his selected department, and second, the general practitioner who, after a few, but not many, years of work, sees that his interest and capacity promises possibility of efficiency. Each class should spend the requisite amount of time in post-graduate study, varying from a year and a half to three years, according to the scope of the specialty and, taking surgery as an example, serve as an assistant to a recognized authority.

The question of the advisability of granting university degrees to specialists was considered and a divided opinion expressed. The major opinion seemed to be that nothing more than a certificate of service should be given, save to those men who have attained distinction through meritorious and original work.

The paper of Dr. J. Whitridge Williams was of special interest to Massachusetts men, for his statements definitely sustained the deductions of the State Commission appointed to consider Maternity and Child Welfare. He emphasized the statistical demonstration that the mortality incident to childbirth is greater in American than in any other civilized country, that out of every 30 births in America, one woman dies, and that the mortality of childbirth in Great Britain is one half, and that in Scandinavia one third of that in this country.

In a personal interview with the writer, he stated his convictions that syphilis, tuberculosis, midwives, and the living conditions of women in this country, tend only slightly to this high mortality, and the remedy lies in the better teaching of obstetrics in the medical schools.

If this means anything, it means that the practice of specialties, like that of some other departments of medicine, must be better conducted. Here again the profession should show interest and, since the subject has been placed before the people of the State, the solution of the problem should lie with the profession, and be dealt with before the laity takes it up. May not the well-equipped obstetric specialist be as useful to the general practitioner as is the eminent surgeon to the average surgeon? Why should the general practitioner be sensitive and resentful because of the study made and the conclusions drawn relating to this subject?

The interest relating to licensure, centered about state reciprocity recognition of the decisions of the medical board and the chiropractic invasion. Dr. Horace D. Arnold represented the National Board and gave a complete exposition of the methods endorsed and used by that board. These matters do not seriously affect this state, because the Massachusetts Board exercises the utmost courtesy toward well-qualified men from other states seeking registration here, and gives credit for years of practice and good standing, so that well-qualified men uniformly secure registration without any great hardship. The Board also practically recognizes the decisions of the National Board and only requires of candidates approved by the National Board, an examination barely sufficient to meet the technical requirements of the law.

The chiropractic question is not at present important in this state, because the college created by one J. Shelby Riley, now or late of Washington, D. C., was put out of business by the Massachusetts Court and the exponents of the cult have been prosecuted and convicted. It is quite probable that no chiropractic school meets the requirements of this state, and hence no graduates have applied for examination.

The discussion of the technical aspect of medical education, hospital administration, and public health, will be of greater interest to specialists in these various fields, rather than practitioners, and will be studied by those especially concerned. These papers will be later printed in full in the *Journal of the American Medical Association*.

It was a pleasure to meet Dr. Hugh Cabot, and hear his comprehensive paper relating to the teaching of surgery in the medical schools and his recommendation for further progress.

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The next annual meeting of the Massachusetts Medical Society will be held in Boston, Tuesday, May 31, and Wednesday, June 1, 1921.

MEDICAL NOTES.

Sewage Disposal in the Country.—A system by which an isolated dwelling (or small group of buildings) having running water may dispose of sewage safely and at small cost, is recommended by the U. S. Public Health Service in one of its recent weekly reports.

The chief feature of the system, which has been in successful operation in New Hampshire for summer cottages and hotels for ten years, is a rectangular septic tank, of concrete, with a minimum capacity of 94 feet. This will serve 20 people; four cubic feet additional should be provided for each additional person.

The tank should be buried under twelve to eighteen inches of earth, as near as practicable to the house, with which it should be connected with piping. The effluent from this tank which contains organic matter that might be quite objectionable and even dangerous, is commonly best disposed of by some sort of subsurface irrigation whose exact form will necessarily be governed by the nature of the soil. Full details are given in the report.

Before installing such a system, however, the State health authorities should be consulted, especially in the limestone sections of the country, where care is necessary to prevent the contamination of springs and other underground waters.

BOSTON AND MASSACHUSETTS.

Health Statistics in Boston.—Health Department officials are very much interested in a case of actinomyosis at the South End. The disease is rare and the last case was reported about six months ago. The patient, in this instance is a young girl who was operated on for appendicitis, that being indicated in the first diagnosis; but the thick discharge, so characteristic of actinomyosis, persisted, and further examination disclosed the fact that she had that disease.

Deaths in Boston, week of March 5, numbered 217. Though 60 cases of diphtheria were reported, only two deaths resulted. The regulations issued by the State Department of Health, insisting on the reporting of encephalitis lethargica, as suggested by Dr. William C. Woodward, Health Commissioner, brought out the fact that nine more new cases of the so-called sleeping sickness are known. This increased the total to 43. There was only one death. The total deaths since the first of the year thus increased to 12.

Of the total deaths, 120 were females and 97 males; 86 were over 60 years old, while 41 were under five years of age. Thirty were infants or less than a year old, and 37 were under the age of two years.

Tuberculosis reached its highest point this winter and claimed 21 victims. Heart disease had 36 and cancer 18. There were ten deaths from broncho-pneumonia and 13 from lobar pneumonia. There were 12 deaths due to accident or violence, and 11 from Bright's Disease and nephritis. There were two deaths due to measles, one to scarlet fever, and three to whooping cough.

Election of Dr. John B. Hawes, 2nd.—Dr. John B. Hawes, 2nd, has been elected President of the Boston Tuberculosis Association. He has secured for the Association the services of Miss Bernice W. Billings, now with the New England Division, American Red Cross. The first work which the Boston Tuberculosis Association plans during the ensuing year is to make a health survey of the City of Boston, as far as tuberculosis is concerned, to be able to map out the future program, to eliminate methods which have been of little value, and to emphasize methods which have shown their worth and in every way to direct the efforts of the Association towards the human and practical side of the tuberculosis problem.

Bequests to Hospitals.—By the will of the late Miss Annie Richards of Boston, the sum of ten thousand dollars each is bequeathed to the Children's Hospital, to the New England Hospital for Women and Children, to the New England Peabody Home for Crippled Children, and to the Boston Nursery for Blind Babies.

The Public Health Service and the Rutland Sanatorium. — Announcement has been made that the Public Health Service has leased the tuberculosis sanatorium nearing completion at Rutland, Massachusetts, for a term of years. It is expected that within two months the sanatorium will be able to accommodate one hundred patients and it will care ultimately for 300. The plans under which the sanatorium is now being enlarged have been approved by the Public Health Service and by the architect of the National Tuberculosis Association on duty with the service. Specialists who have been visiting the tuberculosis hospitals to see that every one of the 20,000 tuberculous ex-service patients shall have the best treatment to be had, have completed their task and have submitted their suggestions. Steps to put these into effect are already in operation in part, and will result in the Government having the very best type of sanatorium.

Week's Death Rate in Boston.—During the week ending March 12, 1921, the number of deaths reported was 229 against 250 last year, with a rate of 15.76 against 16.13 last year. There were 38 deaths under one year of age against 49 last year.

The number of cases of principal reportable diseases were: Diphtheria, 58; whooping cough, 19; scarlet fever, 80; typhoid fever, 2; measles, 85; tuberculosis, 33.

Included in the above, were the following cases of non-residents: Diphtheria, 7; scarlet fever, 8; measles, 2; tuberculosis, 3.

Total deaths from these diseases were: diphtheria, 2; whooping cough, 2; scarlet fever, 3; typhoid fever, 1; measles, 2; tuberculosis, 11.

Included in the above, were the following non-residents: Diphtheria, 1; scarlet fever, 2; tuberculosis, 1.

Encephalitis lethargica cases: 4; death, 1.

Obituary.

WILLIAM FISKE WHITNEY, M.D.

Dr. William Fiske Whitney died at his home in Boston on March 4, 1921, at the age of seventy years. His death was due to cerebral hemorrhage. Dr. Whitney was born in Boston. He was graduated from Harvard in the class of 1871 and from the Harvard Medical School in 1875. He then studied anatomy for three years in Berlin, Munich, and Strassbourg. Upon his return to this country he was appointed pathologist to the Massachusetts General Hospital, and the following year was made curator of the museum of the Harvard Medical School, a position which he held until the time of his death.

From 1883 to 1890 Dr. Whitney was secretary of the medical faculty at Harvard, and from 1891 to 1901 he was actively identified with the veterinary school, where he was professor of parasites and parasitic diseases. He served on the committee appointed to superintend the planning of the building of the old Harvard Medical School on Boylston street in 1880, and 20 years later served in a similar capacity to consider plans for the new group of buildings on Longwood avenue.

Dr. Whitney was president of the Boston Obstetrical Society, and since 1917 had been a vice-president of the Boston Society of Natural History. He was a member of the American Medical Association, the Massachusetts Medical Society and other organizations. He was at various times connected with the Boston Athletic Association, the Union, St. Botolph and Harvard clubs, The Brookline Country Club and the Corinthian, Eastern and Boston Yacht Clubs. He is survived by a widow and two sons, Lyman F. Whitney, Harvard '10, and William E. Whitney, Harvard, '16.

Miscellany.

TYPHUS FEVER WARNING.

At the present time, people are constantly coming to this country from parts of Europe where typhus fever is prevalent. In spite of the precautions of the Federal Quarantine authorities, both abroad and at our own seaports, cases of typhus fever, probably due to recently imported infection, have occurred among the resident population of New York City and of other places. It is, therefore, not improbable that cases of the disease may be found in Boston, either among recently arrived immigrants or the permanent population. In such an event, the prevention of a serious outbreak here of the virulent type of the disease, now common in Eastern Europe, may depend upon the prompt recognition of any case of the disease in this city.

Physicians should, therefore, keep constantly in mind at the present time, the possibility of typhus fever, in all cases of an acute illness with sudden onset, high temperature, marked prostration, ocular congestion, severe headache and mental apathy, in which the diagnosis may be in doubt, particularly if a dark "rose spot" or petechial eruption appears a few days after onset of illness. In any case in which a suspic ion of typhus fever arises, you are requested to notify the Health Department at once. If desired, diagnostic assistance in any such case will be promptly furnished you without charge. Should you desire such assistance, telephone Fort Hill 5100, Health Department, Medical Division, between the hours of 9 A.M. and 5 P.M., daily, and Saturday until 1. At all other times call Main 3887.

That the diagnosis of a case of typhus fever may not be easy, is indicated by the fact that typhus fever of a mild type (Brill's disease) is endemic in this country and that it existed for many years before its true character was recognized, cases being usually mistaken for atypical typhoid fever. Experience has shown also, that typhus fever may be mistaken for cerebro-spinal meningitis, pneumonia or influenza.

Since typhus fever has been seldom seen by physicians in this city, it may not be improper to remind you of the characteristic symptoms of a typical case.

Symptoms. The main symptoms are sudden onset with severe headache; high temperature, of 103° to 105°, and fall by rapid lysis to normal in about two weeks; pulse rapid, from 100 to 120; the tongue at first has a white coat, which rapidly becomes brown and very dry, with sordes on the teeth; bowels are constipated; delirium is a common symptom. The headache usually persists with the fever, and is frontal and severe in character. The expression is dull; eyes are congested; respiration is rapid; spleen is enlarged. The eruption usually appears on the third to the fifth day. The spots are smaller than those of measles, are distributed over the covered portion of the body chiefly, and may appear on the hands and feet, but rarely appear on the face. The spots are red at first and then of a dirty bluish color. On the third or fourth day of the eruption there is extravasation of blood into the lesions which form dark colored spots underneath the skin. The eruption becomes of a darker color as it becomes older. The eruption is one of the best differential guides.

In mild cases the symptoms described above may be so modified as to cause the difficulty in diagnosis already referred to.

Needless to say, all suspicious symptoms assume a graver aspect if they occur in a person recently arrived in this country from abroad, or in a person known to have been exposed to infection.

Diagnosis by the Agglutination Test—Weil-Felix Reaction. The Bacteriological Laboratory of the Boston Health Department is prepared to examine blood specimens from cases suspected to be suffering from typhus fever. This reaction, while not specific in character, is fairly reliable. The reaction appears during the first week of the disease and becomes quite marked during the second week and during convalescence.

Directions for Taking and Forwarding Specimens to Laboratory. Procure a specimen of blood in a manner similar to obtaining a specimen for Widal examination, using a similar outfit. Dry the specimen in the air, and forward it to Laboratory through mail or by special messenger.

Age Period. The disease is usually found in adults and seems to be rare in children under five years.

Cause of Disease. The disease is presumably due to an organism, which is to be seen in infected lice and in the lesions of the disease, but which has not yet been artificially cultivated.

Mode of Transmission. It has been well established that the disease is transmitted by body lice and by head lice, and apparently is not spread in any other manner. The lice become infected by feeding on persons infected by typhus fever and become themselves carriers of the disease. Where lice are abundant there is the greatest danger of the disease being spread. Overcrowding, uncleanliness, and poor sanitary conditions favor the spread of typhus fever, because these conditions are favorable for the distribution of lice from person to person.

Treatment. There is no specific treatment. Patient suffering from typhus fever will not be allowed to stay at home, but will be removed to a hospital. Contacts will be thoroughly deloused, together with such articles or clothing as the Health Department may deem necessary. The premises will be deloused. Contacts after delousing will be kept under supervision of the Health Department until all danger of infection has passed.

Wm. C. Woodward,
Health Commissioner.

Correspondence.

THE PREVENTION OF MALARIA.

Mr. Editor:—

You have shown in your editorial in today's issue, that the most effective way to prevent malaria is to destroy the malarial parasite in the blood of the carriers of it. This I have tried to show by what I have written, more than once, and especially during the last year.

There are two medical agents which will do it, and only two. Quinine will not—at least, it will not in many instances, especially the virulent cases such as those so often taken in southern climates. Compound tincture of bark, taken frequently and in sufficient doses, will destroy the malarial germ in most instances. This is also true of Warburg's tincture. I deem it a matter of the very highest practical importance to disseminate very widely this truth. Aside from the immense benefit which would result to the health of individuals and communities, the saving of millions of dollars to the United States and, indeed, in every country where malaria shows its fearful ravages, is, to my mind, unquestionable. I beg that you will emphasize, forcibly, my affirmations and, if you desire, will give you the references precisely of what I have written previously on the subject. Among them I would now cite the following, which have appeared lately. In the *New York Medical Record* of December 11, 1920, you will find "When quinine and even the combined alkaloids fail to do good work in curing malaria, the compound tincture of bark will, I believe, do the trick and bring to a rapid end all evidences of malaria so far as symptoms are concerned, and also at times, any evidences that can proceed from laboratory research." In November, 1920, issue of the *American Journal of Clinical Medicine*. page 763, I affirm as stated above and deplore "the neglect into which two of the old-time remedies have fallen, namely: Warburg's tincture and compound tincture of bark." The last textual quotation is from the editorial in the January, 1921, issue of the *American Journal of Clinical Medicine.*

Beverley Robinson, M.D.

New York, March 2, 1921.

AN EARLY SUCCESSFUL GASTROTOMY.

Mr. Editor:—

The following account is given by Baron Larrey in his Memoirs (Austerlitz, Poland, Vol. II, pp. 178, 179, American Edition, 1914).

The incident of which Larrey writes must have occurred at Toulouse between 1780 and 1787, as he was then a student there under his uncle, Alexis Larrey.

> "Authors give a great number of cases in which foreign bodies of large volume have been introduced into the stomach, and have been discharged per anum, or have made their way out spontaneously; but do not speak of operations on this viscus for the purpose of extracting foreign bodies that have lodged in this organ and produced alarming symptoms.
>
> "I remember, while a pupil with Mr. Frizac, professor of the college of Toulouse, one of the most dextrous surgeons of that city, that I saw him operate on a porter, by making an incision in the epigastric region, parallel with the linea alba, through which he discovered the point of a knife blade that had perforated the coats of the stomach. He seized the point with a pair of strong forceps, enlarging the opening with a curved bistoury, and took out the fragment, which proved to be about two inches in length. He then put two sutures into the lips of the incision of the stomach, and an interrupted suture in the integuments. This porter recovered. Threads of different colors were used in the sutures, and on the fifth day the wound of the stomach had united, no doubt by adhering to the peritoneum."

In regard to this subject, Larrey also states:

> "At Königsberg, we also saw a small knife which a farmer, named Andreas Guenheid of Ancient Prussia, had swallowed in 1613. The violent symptoms which ensued induced Dr. Gruger, a Polish surgeon, to perform gastrotomy upon him. It was done on the twenty-ninth of May of the above year, and he lived afterward ten years."

Very truly yours,
William Pearce Coues, M.D.

31 Massachusetts Avenue, Boston,
March 7, 1921.

SOCIETY NOTICES.

The Norfolk District Medical Society.—A regular meeting of the Society will be held at Masonic Temple, 171 Warren Street, Roxbury, Tuesday, March 29, 8.15 P.M. Telephone, Roxbury 56089.

Business; Communication, "The X-ray Diagnosis of Phthisis," illustrated. by Frederick W. O'Brien. M.D.; Discusion by Arial W. George, M.D.

Bradford Kent, M.D., *Secretary.*

Brooklyn Cardiological Society.—The third meeting of the Brooklyn Cardiological Society wll be held at the office and residence of the president, Dr. William J. Cruikshank, 102 Fort Greene Place, Brooklyn, New York, on Thursday evening, March 31, at 8.30 o'clock.

PROGRAM.

1. Presentation of patient demonstrating the beneficial effects of physical exercise in the treatment of valvular disease. Dr. Cruikshank.
2. Paper: "The Effects of the Vagus Nerve on the Heart Beat." William W. Laing, M.D.
3. Discussion: Dr. Robert Hurtin Halsey, Manhattan; Dr. Walter Timme, Manhattan.

General discussion.

W. J. Cruikshank, *President,*
William W. Laing, M.D., *Secretary.*

RECENT DEATHS.

Dr. Clarence Albert Pettengill died on February 24, at his home in Wellesley Hills, at the age of 45 years. His death was caused by double pneumonia. Dr. Pettengill was born in Middletown, Conn., the son of Dr. Joel M. Pettengill, a dentist, and Emily (Parker) Pettengill. He was a graduate of Tufts College in 1900 and of the Tufts Dental School in 1903. Since that time he had been practising dentistry in Boston. At one time Dr. Pettengill was head of the prosthetic department of Tufts Dental School. In 1911 he married Miss Helen Ramsay of Cambridge, by whom he is survived. His parents also survive him. Dr. Pettengill was a member of a number of dental societies.

William Fiske Whitney, a Fellow of the Massachusetts Medical Society, died, of cerebral hemorrhage, at his home in Boston, March 4, 1921, aged 70 years.

Dr. Amasa Howard, a Fellow of the Massachusetts Medical Society and a native of Chelmsford, died in that town March 3, 1921, aged 63 years. He was a graduate of Dartmouth Medical School in 1882 and had practised in Chelmsford all his life.